PATENT
03345-P0017A WWW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	Michael Heuken, *et al.*
Serial No. - Pending	Filing Date: June 1, 2001
Title of Application	Method And System For Semiconductor Crystal Production With Temperature Management

Assistant Commissioner for Patents
Washington, DC 20231

Preliminary Amendment

Dear Sir:

Please enter this preliminary amendment before examination of this case.

In the Claims:

3. Method according to Claim 1 [or 2],

characterised by control of the temperature T_2 as equal to the temperature T_3.

4. Method according to [any of the Claims 1 to 3] Claim 1,

characterised by controlling the temperature T_3 as a constant and up to 1600 °C, with required reproducible temperature variations of up to 250 °C per minute.

5. Method according to [any of the Claims 1 to 4] Claim 1,

characterised by controlling the temperature T_4 as a correlate to the temperature T_3 with an accuracy of 0.1 °C.

6. Method according to [any of the Claims 1 to 5] Claim 1,

characterised by controlling the temperature T_5 to a value smaller than the value of the temperatures T_4 and T_3.

7. Method according to [any of the Claims 1 to 6] Claim 1,

   characterised by controlling the temperature T_6 as a constant smaller than T_1.

8. Method according to [any of the Claims 1 to 7] Claim 1 ,

   characterised by controlling the temperature T_7 as a constant and correlate to T_3.

9. Method according to [any of the Claims 1 to 8] Claim 1,

   characterised by controlling the temperature T_8 as a constant and correlate to T_3.

10. Method according to [any of the Claims 1 to 9] Claim 1,

    characterised by additionally controlling a temperature-dependent gas flow variation.

11. Method according to [any of the Claims 1 to 10] Claim 1,

    characterised by additionally controlling a temperature-dependent total pressure variation in the reaction chamber.

12. Method according to [any of the Claims 1 to 11] Claim 1,

    characterised by additionally controlling a temperature-dependent principal carrier gas variation in the reaction chamber.

13. Method according to [any of the Claims 1 to 12] Claim 1,

    characterised by additionally controlling temperature-dependent interrupts in the production process.

14. Method according to [any of the Claims 1 to 13] <u>Claim 1,</u>

characterised by applying the semiconductor materials to be produced on a mechanical carrier of a semiconductor of group IV, a semiconductor of groups III-V, oxides or any other material resistant to temperatures and the process gases.

15. Method according to [any of the Claims 1 to 14] <u>Claim 1,</u>

characterised by pre-treating said mechanical carrier by applying lines, dots, or by carrying out other steps for surface treatment, or by partially covering the surface with other materials or material components.

16. Method according to [any of the Claims 1 to 15] <u>Claim 1,</u>

characterised by two-stage application of pre-processed $A_XB_YC_ZN_VM_W$ materials.

17. Method according to [any of the Claims 1 to 16] <u>Claim 1,</u>

characterised by the employment of a temperature-controlled injector.

Respectfully submitted,

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Replacement claims per § 1.121 (c) (30)

1. Method of producing nitrogenous semiconductor crystal materials and particularly of strata on wafers of the form $A_XB_YC_ZN_VM_W$, wherein A, B, C represent elements of group II or III, N represents nitrogen, M represents an element of group V, with the exception of N, or group VI, and X, Y, Z, V, W represent the mol fraction of each element in this compound, operating on a device comprising

   - a reaction chamber wherein at least one wafer support is disposed,
   - at least one gas inlet through which the process gases flow into said reaction chamber in a controlled succession,
   - possibly a gas mixing system,
   - a gas outlet through which the process gases are discharged again after they have flown through said reaction chamber, and a controller that controls or controls in a closed loop, respectively, the type or the composition of the in-flowing process gases and the temperature of the wafer, as well as possibly further parts of said reaction chamber,

   characterised in that for the selective adjustment of the characteristics of the materials so produced, in addition to the control of the absolute temperature of the wafer and/or at least one part of said reaction chamber, also the temperature variation of at least this part or another part of said reaction chamber, e.g. the gas inlet T_1, the chamber walls T_2, the principal wafer support T_3, rotating individual wafer supports T_4, the gas outlet T_5, said gas mixing system T_6, the upper side of said reaction chamber T_7 and/or said heating system T_8 are adjusted with temperature variation profiles within the range of seconds in such a way that the variation of the process parameters so caused results in a dynamic control of the thermal processes leading to the production of the materials.

2. Method according to Claim 1,

   characterised by controlling the temperature T_1 below the condensation temperature of the gases and by adjustment of the temperature for avoiding the formation of addition compounds.

3. Method according to Claim 1,

characterised by control of the temperature T_2 as equal to the temperature T_3.

4. Method according to Claim 1,

characterised by controlling the temperature T_3 as a constant and up to 1600 °C, with required reproducible temperature variations of up to 250 °C per minute.

5. Method according to Claim 1,

characterised by controlling the temperature T_4 as a correlate to the temperature T_3 with an accuracy of 0.1 °C.

6. Method according to Claim 1,

characterised by controlling the temperature T_5 to a value smaller than the value of the temperatures T_4 and T_3.

7. Method according to Claim 1,

characterised by controlling the temperature T_6 as a constant smaller than T_1.

8. Method according to Claim 1,

characterised by controlling the temperature T_7 as a constant and correlate to T_3.

9. Method according to Claim 1,

characterised by controlling the temperature T_8 as a constant and correlate to T_3.

10. Method according to Claim 1,

    characterised by additionally controlling a temperature-dependent gas flow variation.

11. Method according to Claim 1,

    characterised by additionally controlling a temperature-dependent total pressure variation in the reaction chamber.

12. Method according to Claim 1,

    characterised by additionally controlling a temperature-dependent principal carrier gas variation in the reaction chamber.

13. Method according to Claim 1,

    characterised by additionally controlling temperature-dependent interrupts in the production process.

14. Method according to Claim 1,

    characterised by applying the semiconductor materials to be produced on a mechanical carrier of a semiconductor of group IV, a semiconductor of groups III-V, oxides or any other material resistant to temperatures and the process gases.

15. Method according to Claim 1,

    characterised by pre-treating said mechanical carrier by applying lines, dots, or by carrying out other steps for surface treatment, or by partially covering the surface with other materials or material components.

16. Method according to Claim 1,

    characterised by two-stage application of pre-processed $A_XB_YC_ZN_VM_W$ materials.

17. Method according to Claim 1,

    characterised by the employment of a temperature-controlled injector.

18. Device for producing nitrogenous semiconductor crystal materials and particularly of strata on wafers of the form $A_XB_YC_ZN_VM_W$, wherein A, B, C represent elements of group II or III, N represents nitrogen, M represents an element of group V, with the exception of N, or group VI, and X, Y, Z, V, W represent the mol fraction of each element in this compound, comprising

    - a reaction chamber wherein at least one wafer support is disposed,
    - at least one gas inlet through which the process gases flow into said reaction chamber in a controlled succession,
    - possibly a gas mixing system,
    - a gas outlet through which the process gases are discharged again after they have flown through said reaction chamber, and
    - a controller that controls or controls in a closed loop, respectively, the type or the composition of the in-flowing process gases and the temperature of the wafer, as well as possibly further parts of said reaction chamber,

    characterised in that for the selective adjustment of the characteristics of the materials so produced, said controller adjusts, in addition to the control of the absolute temperature of the wafer and/or at least one part of said reaction chamber, also the temperature variation of at least this part or another part of said reaction chamber, e.g. the gas inlet T_1, the chamber walls T_2, the principal wafer support T_3, rotating individual wafer supports T_4, the gas outlet T_5, said gas mixing system T_6, the upper side of said reaction chamber T_7 and/or said heating system T_8 with temperature variation profiles within the range of seconds in such a way that the variation of the process parameters so caused results in a dynamic control of the thermal processes leading to the production of the materials.